

# Introduction to Turbomachinery

The result of many years of teaching, research, and consulting within universities and the professional turbomachinery industry, this unique book presents comprehensive coverage of fundamental principles and industrial design, and also covers turbomachinery application diversity. It focuses on basic physical understanding but acknowledges advances in modern computing methods and experimental techniques made to the turbomachinery industry.

The text features an introduction to the broad diversity of turbomachinery - including pumps, compressors, and turbines - and its application in areas such as gas turbines, process compressors and expanders, turbochargers, and hydraulic turbines and pumps.

## Introduction to Turbomachinery

- General Introduction
- Introduction to Process Machinery
- Introduction to Turbochargers
- Introduction to Gas Turbine Staging
- Introduction to Pumps
- Hydraulic Turbomachinery
- Performance Modeling Parameters

## Essentials of Turbomachinery Performance

- The Euler Turbomachinery Equation
- The Euler and Bernoulli Equations (Forces and Momentum Along a Streamline)
- The Euler-n Equation (Forces and Momentum Normal to a Streamline)
- Velocity Triangles and Vector Summation
- Thermodynamic Properties in Turbomachines
- Work Transfer, the Isentropic Process, and Efficiency
- Loss Coefficients
- Diffusion
- Reaction
- Tracking the Flow Development in Turbomachine Passages
- Special Effects in Turbomachinery: Choke and Cavitation

## Essentials of Turbomachinery Durability

- Cycle Specification, Failure Mechanisms, and Cumulative Damage
- Yield Strength and Practical Stress Limits
- Creep and the Larson-Miller Plot
- Principal Fatigue Modes and the Goodman Diagram
- Vibration Characteristics and the Campbell Diagram
- Characteristics of Low Cycle Fatigue
- Cumulative Damage Accounting

## Centrifugal Compressors and Pumps

- Impeller Inlet

- Impeller Exit
- Vaneless Diffuser
- Vaned Diffuser
- Volute or Return Channel
- Examples

## Axial Fans, Compressors, and Pumps

- Introduction
- Basic Analysis of a Stage
- Mean Line Analysis
- Blade Loading
- Cascade Performance
- Axial Compressor Stage Performance Prediction
- Modern Through Flow Calculations
- Axial Pump Example

## Axial Turbines

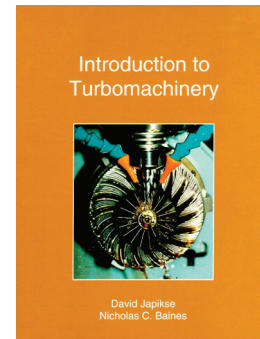
- Fundamental Principles and Definitions
- Turbine Design Objectives
- Three-Dimensional Design
- Setting Out the Blade Profile
- Performance Estimation and Loss Modeling
- Analysis of Loss Components
- Examples

## Radial Turbines

- Basic Analysis of a Stage
- Radial Turbine Stage Performance
- Turbine Rotor Loss Modeling
- The Volute
- The Nozzle
- Variable Geometry Stators

## Modeling Turbomachinery Flows

- Simple Performance Prediction Methods
- Boundary Layer Flows
- Diffusers
- The Computation of Blade Passage Flows
- Case Studies



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## Stability and Range

- Introduction to Stall, Stage Stall, and Surge
- Classes of Steady Stall for Compressors and Pumps
- Rotating Stall in Centrifugal and Axial Compressors
- Stage Stall
- System Surge for Compressors
- System Surge for Pumps
- Separation in Turbines
- Summary

## The Design Approach

- Overview of Design Techniques
- Sample Design Problem
- Design Critique

## Experimental Methods for Turbomachinery Development

- Introduction
- Experimental and Development Test Facilities
- Instrumentation
- Shop Techniques
- Flow Survey Instruments
- Calibration, Accuracy, and Uncertainty
- Sample Data

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